OBSERVATIONS ON THE BIOLOGY OF *HIPPOSIDEROS LANKADIVA* KELAART, 1850 (CHIROPTERA, RHINOLOPHIDAE)[1]

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Hipposideros lankadiva roosts in deserted temples and subterranean caves in association with certain other species of frugivorous and insectivorous bats. There is a year round fluctuation in their population in their roosts, depending upon the reproductive status of the colony. The species has a single estrous cycle each year, with pregnancy from February to May and parturition in May and June. The suckling period is estimated to be six to eight weeks. Males generally segregate from the females during later part of pregnancy or during nursing of the neonates. While foraging, females leave behind their neonates in the roost. At birth the male to female percentage is 55:45.

Hipposideros lankadiva is the largest *Hipposideros* found in Peninsular India and Sri Lanka with forearms of the adults measuring 80 to 90 mm. The subspecies entities given by Anderson (1908) for various forms are now clubbed together (Tate 1947, Ellerman and Morrison-Scott 1951, Brosset 1962). The information on the biology of this species has been summarised by Brosset (1962).

This communication presents some additional information on the biology of this species collected during a serological survey of bats in the Kyasanur Forest disease area and its neighbourhood between 1969 and 1978 (Bhat *et al.* 1978).

Material and Methods

The colonies were traced by searching the known ancient temples and by enquiring with villagers. Whenever possible, the colonies were visited periodically and the ecological data, associated species and approximate population size were recorded. Samples of specimens were collected with the help of sweepnets and mistnets, and their weight and reproductive status were recorded. For females, the status of mammae, false teats and lactation were recorded. Each adult female was dissected and the grossly visible embryos, when present, were removed along with the embryonic membranes and surrounding uterine wall and weighed. Depending upon the weight, colour and reproductive status each specimen was arbitrarily classified as neonate, juvenile or adult.

Observations

Colonies recorded:

Eleven colonies recorded during the study are listed with ecological details in table 1. Of the 11 colonies, those at Sampagaon, Bailhongal, Chandravalli, Banavara, Kamalashile and Manki were visited only once. Thigadi colony was first visited on October, 1969 and subsequently on 29 June, 1970, 12 February, 1971, 18 June, 1971 and 5 August, 1971. Yellapur colony was visited thrice. The colonies at Nislneer and Muroor are still under periodic observations.

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Breeding cycle:

Because of the migratory habit of the species and the population fluctuation, it was not possible to make a monthly collection of adequate number of specimens from any colony throughout the year. However, the overall observations on several colonies and a number of collections made at Nislneer and Muroor have enabled us to construct an approximate picture of the breeding cycle of the species.

At Nislneer, 38 out of 53 adult females collected during February, March and April were in various stages of pregnancy (Table 2). The embryos weighed between 0.02 to 8.0 gm. The smallest embroys were seen in February and the largest in April. Three specimens carrying suckling babies and one lactating female were collected in May and June respectively. Juvenile specimens were seen between June and December. It was not possible to differentiate the juveniles from adults after December.

In all 149 adult females were collected from Gersoppa, Muroor and Kamalashile, of which 16 were pregnant, 91 were carrying suckling babies and 11 were lactating (Table 3). The March sample had the smallest embryos weighing an average of 0.75 gm, while the May sample had the largest weighing an average of 11.4 gm. Neonates were seen between the last week of May and middle of June. A few free flying juveniles were first seen in the first week of June. The pregnancy was invariably in the left uterus with the exception of two individuals.

The adult females including the pregnants weighed an average of 38.5 gm (31.8 to 45.8 gm). The adult males weighed an average of 44.0 gm (30.0 to 61.0 gm).

Associated species:

H. lankadiva was observed to share the habitat with seven other species of bats namely, *Rousettus leschenaulti, Eonycteris spelaea, H. speoris, Rhinolophus rouxi, R. lepidus, Miniopterus schreibersi* and *Megaderma lyra* (Table 1). In the mixed colonies *H. lankadiva* either occupied a separate area of the habitat or mixed freely with the associated species, particularly with *R. leschenaulti* and *H. speoris.*

Population fluctuation and Social habits:

During the first collection at Thigadi on 19 October 1969, the colony had about 3000 individuals of adults and juveniles. In February, 1971 the habitat was free from this species. In June 1971 the colony was in full strength with more than 3000 individuals consisting of juveniles and lactating females carrying neonates. The small colonies located at Sampagaon and Bailhongal appeared only during the rainy season from June to August, and consisted of adults. Ten specimens collected from Yellapur on 28 June 1970 were all males. Subsequently only one bat was seen on 27 March 1971 and none on 17 June 1971.

The Muroor cave, when first visited on 29 March 1972, did not have any *H. lankadiva.* During the second visit on 31 May 1972 a colony of about 200 females and 100 males was seen. Most of the females were carrying babies. The adult males occupied a separate part of the cave away from females. In the evening the bats started emerging at 19.15 hrs. While *Rousettus leschenaulti* was the first to emerge from the cave, *H. lankadiva* was the last to emerge. When the empty cave was surveyed at 20.15 hrs, three adults and a group of 86 neonates were seen. The neonates were deposited individually on the side wall with 10 to 20 cm spacing between each other. All neonates were with sealed eyelids. Majority of them had greyish brown fur and rest were naked. Of the 64 neonates 35 were males and 29 were females giving an approximate 55:45 male-female percentage.

TABLE 1

RECORDS OF COLONIES OF *H. lankadiva*

Sl. No.	Locality & District	First recorded on	Habitat	Estimated Number	Number collected	Associated species
1	Thigadi Belgaum	19-10-1969	Dome of a temple	3000	235	*Rousettus leschenaulti, Miniopterus schreibersi*
2	Yellapur North Kanara	28-6-1970	Deserted temple	20	10♂	*Rhinolophus rouxi*
3	Gersoppa North Kanara	15-3-1971	Deserted temple	50	15♂, 14♀	*Hipposideros speoris*
4	Sampagaon Belgaum	5-8-1971	Dome of a mosque	50	Nil	Nil
5	Bailhongal Belgaum	18-6-1971	Chimney of an oil mill	1	Nil	Nil
6	Chandravalli Chitradurga	25-6-1971	Subterranean tunnel	50	1 ♂ (Juvenile)	*Megaderma lyra*
7	Banavara Hassan	28-7-1971	Deserted temple	40	2 ♂ (Juvenile)	Nil
8	Muroor North Kanara	31-5-1972	Subterranean cave	50	6♂, 11♀	*Rousettus leschenaulti, Eonycteris spelaea, Hipposideros speoris*
9	Nislneer North Kanara	16-3-1973	Subterranean cave	500	2♂, 3♀	*Rousettus leschenaulti, Eonycteris spelaea*
10	Kamalashile South Kanara	10-4-1973	Subterranean cave	1000	10♀	*Rhinolophus lepidus*
11	Manki North Kanara	7-4-1975	Subterranean cave	20	Nil	*Hipposideros speoris*

TABLE 2

ANALYSIS OF SAMPLES OF *Hipposideros lankadiva* COLLECTED AT NISLNEER

Date	Adult females					Adult males	Neonates	Juveniles	Total
	Total No.	No. pregnant	Wt. of embryo (grams)	Suckling mothers	Lactating females				
16-3-73	3	3	0.1-1.1 (0.7)	—	—	2	0	0	5
22-4-73	8	6	5.4-8.0 (5.9)	0	0	5	0	0	13
17-5-73	3	0	—	3	—	15	3	0	21
9-6-73	0	—	—	—	—	8	0	0	8
19-7-73	0	—	—	—	—	6	0	0	6
27-8-73	0	—	—	—	—	13	0	0	13
4-10-73	0	—	—	—	—	0	0	0	0
30-10-73	0	—	—	—	—	0	0	0	0
29-11-73	1	0	—	0	0	1	0	0	2
28-12-73	1	0	—	0	0	0	0	1♀	2
31-1-74	0	—	—	—	—	0	0	0	0
28-2-74	13	9	0.05-0.15 (0.09)	0	0	0	0	0	13
28-3-74	7	6	0.6-1.4 (0.94)	0	0	0	0	0	7
29-4-74	0	—	—	—	—	0	0	0	0
28-5-74	0	—	—	—	—	0	0	0	0
28-6-74	1	0	—	0	1	3	0	3♀	7
24-7-74	0	—	—	—	—	7	0	0	7
23-8-74	0	—	—	—	—	8	0	2♀,1♂	11
30-9-74	0	—	—	—	—	2	0	2♀,2♂	6
31-10-74	0	—	—	—	—	0	0	0	0
26-11-74	0	—	—	—	—	0	0	1♀	1
30-12-74	0	—	—	—	—	1	0	0	1
30-1-75	0	—	—	—	—	0	0	0	0
3-3-75	15	14	0.02-0.2 (0.07)	0	0	3	0	0	18
7-4-75	1	0	—	0	0	0	0	0	1
8-5-75	0	—	—	—	—	0	0	0	0
Total	53	38	—	3	1	74	3	12	142

TABLE 3

ANALYSIS OF SAMPLES OF *Hipposideros lankadiva* COLLECTED FROM GERSOPPA, MUROOR AND KAMALASHILE

Locality	Date	Adult females					Adult males	Neonates	Juveniles	Total
		Total No.	No. pregnant	Wt. of embryos (grams)	Suckling mothers	Lactating females				
Gersoppa	15-3-71	9	5	0.5-1.0 (0.75)	0	0	11	0	0	20
„	2-6-71	24	0	—	13	6	32	13	1♀, 3♂	73
„	2-11-71	3	0	—	0	0	5	0	0	8
Muroor	31-5-72	9	0	—	4	5	4	2♀, 2♂	0	17
„	3-6-72	15	0	—	15	—	0	7♀, 8♂	0	30
Kamalashile	10-4-73	10	7	1.9-3.0 (2 8)	0	0	0	0	0	10
Muroor	23-5-75	5	4	9.9-13.9 (11.4)	1	—	7	1	0	13
„	16-6-75	38	0	—	38	—	0	18♀, 20♂	0	76
„	1-6-78	20	0	—	20	—	0	9♀, 11♂	0	40
„	20-1-79	0	—	—	—	—	0	0	0	0
„	10-4-79	0	—	—	—	—	0	0	0	0
„	20-8-79	16	0	—	0	0	15	0	2♀, 4♂	37
Total		149	16	—	91	11	74	91	10	324

The Nislneer colony, where two years study was done, had approximately 500 individuals on 22 April, 1972. On 17 May, 1972 the colony was depleted to about 250 individuals. Three females with neonates and 15 males were collected. On the same night the cave was examined at 20.30 hrs. Six naked neonates with sealed eyelids were clinging to the wall with a spacing of about 30 cm.

Homing:

Eleven bats trapped at Gersoppa on 15 March 1971 were marked by clipping a small triangular piece from the right or left ear. They were released at 8 and 13 miles from Gersoppa at 21 hrs. On 19 March one of the specimen, marked and released at a distance of 8 miles, was recovered. Again on 2 June two specimens released at the same place were recovered.

Discussion

Eleven colonies of *H. lankadiva* were recorded during the present study. The largest colony at Thigadi had about 3000 individuals. The species is as common as *H. speoris* and *H. bicolor*, the other two common species of *Hipposideros* found in the area. Apparently, the species is not so rare as presumed by Brosset (1962). Periodic and year round observations made on some of the colonies have revealed that the species does not stay permanently at one place. Maximum concentration takes place during the breeding season and the males have a tendency to segregate during the late pregnancy and parturition period. Contrary to the observation recorded by Brosset (1962), hibernating colonies were not observed during the study.

The species apparently follows the reproductive pattern of the majority of Microchiroptera (Wimsatt and Trapido 1952) with a mono-estrous restricted breeding season. Grossly visible embryos were first observed in the month of February and the neonates during the later half of May and earlier half of June. This suggests a gestation period of about 5 months. Each female produces only one young at each pregnancy which is generally conceived in the left uterus. While foraging, the females leave behind the neonates in the habitat and pick them up when they return. This is consistent with the observations made on some other species of bats (Bhat *et al.* 1973).

The segregation and migration of bats do not permit the determination of exact sex ratio (Gopalakrishna and Madhavan 1970). During the present study an approximate estimation was done on the suckling neonates and the male-female percentage of 55 to 45 was recorded. This aproximates with the estimation of sex ratio by Abdulali (1949).

Acknowledgements

We are grateful to the Director, National Institute of Virology, Pune for the keen interest in the study and encouragement. Technical assistance received from the staff is gratefully acknowledged.

References

Abdulali, H. (1949): Sex ratio in Indian bats. *J. Bombay nat. Hist. Soc. 48*: 423-427.

Bhat, H. R., Sreenivasan, M. A. and Geevarghese, G. (1973): Community rearing in *Rhinolophus rouxi* Temminck, 1835 (Chiroptera, Rhinolophidae) in KFD area, Shimoga District, Mysore State. *J. Bombay nat. Hist. Soc. 69*: 645-646.

Bhat, H. R., Sreenivasan, M. A., Goverdhan, M. K., Naik, S. V. and Banerjee, K. (1978): Antibodies to Kyasanur Forest disease virus in bats in the epizootic-epidemic area and neighbourhood. *Indian J. Med. Res. 68*: 378-392.

BROSSET, A. (1962): The bats of central and western India. Part 2. *J. Bombay nat. Hist. Soc. 59*: 583-624.

ELLERMAN, J. R. AND MORRISON-SCOT, T. C. S. (1951): Checklist of palaearctic and Indian mammals. British Museum (Nat. Hist.) London, 810 pp.

GOPAPALAKRISHNA, A. AND MADHAVAN, A. (1970): Sex ratio in some Indian bats. *J. Bombay nat. Hist. Soc. 67*: 171-175.

TATE, G. H. H. (1947): Mammals of Eastern Asia. Macmillan, New York, 366 pp.

WIMSATT, W. A. AND TRAPIDO, H. (1952): Reproduction and reproductive cycle in the tropical American Vampire bat, *Desmodus rotundus murinus*. *Amer. J. Anat. 91*: 415-446.